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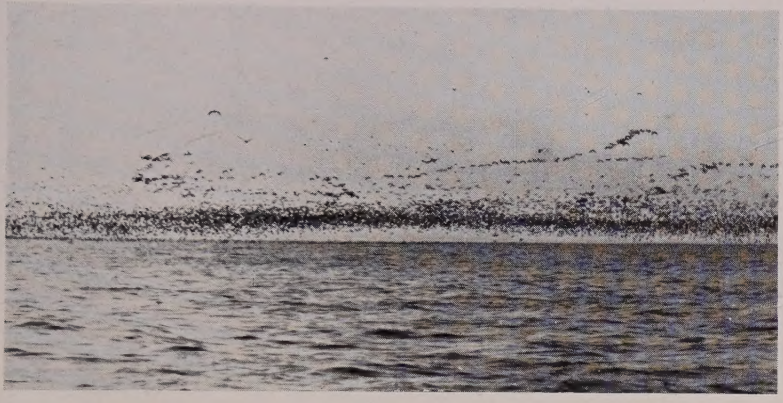
Cormorants or "guanays," the principal guano producers, gathering to form their dense nesting colonies on Chincha Islands, off Pisco, Peru.



The Guano Islands of Peru

KARL P. SCHMIDT*
With Photographs by William Vogt

A TRAVELER to Peru, whose attention has been caught by the increasing wealth of bird life as his ship enters the cold waters of the Humboldt Current, from the north, will be interested also in the gleaming white color of the coastal islets. If he passes these islands at the right season, the clouds of black and white cormorants, which will be streaming away from them in the morning or toward them in the evening, may give him a clue to the fact that their rocks are painted white by the excrement of nesting sea birds. He will then remember that Peru is famous for its production of guano, the accumulated droppings of these birds on offshore islands.

About a hundred years ago the value of this guano as a fertilizer of unsurpassed value for soils and crops of all kinds was rediscovered. It had been known to the Incas, and had been used in their extraordinarily intensive terrace cultivation of the Peruvian valleys. The deposits on the Chincha Islands, off Pisco, were then more than a hundred feet in depth. Their value and easy accessibility to sailing vessels led to an era of wild exploitation. With the resulting revenues, the Peruvian government of that time entered upon a period of lavish public expenditure with no thought of the future and still less of the fact that the guano deposits were limited. By the decade of the seventies, the end of the guano exploitation on the Chinchas was in sight. Other islets, with smaller and poorer deposits, were exploited in turn; but by the end of the century the accumulation of guano over thousands of years

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had been completely removed. Necessity mothered a modern era of conservation. This has developed under a group of enlightened Peruvian government officials and business men, and has given rise to the employment of a succession of North American biologists as technical advisers; among these we may mention R. E. Coker (in Peru from 1906-1908), R. C. Murphy, and the biologist now in charge, William Vogt. Under modern conditions, the islands are swept clean of their accumulation of guano every two years. The problems faced by the biologists are principally to achieve a minimum disturbance of the great colonies of birds and possibly to increase the areas of nesting ground available to them.

A Mecca for Scientists

The unparalleled concentration of marine life in the Humboldt Current, made conspicuous by the clouds of birds, makes the Peruvian coast a focus of biological interest. Great and unique phenomena of oceanography are brought within reach of observation and study, and the modern Peruvian efforts at intelligent conservation provide facilities and continuity for such studies. Among the birds themselves we are brought immediately into contact with major problems. A "species" is something of an abstraction to the museum worker, with his dried or alcohol-preserved "museum specimens" serving as a kind of counter. A species is something quite different—and certainly much more real—when it can be seen almost as a whole, as a feature of the landscape, with its millions of individuals. It is then seen to be an obviously distinct element in a community including a number of very distinct species of birds, dependent on a vast chain of marine organisms as food, and associated with parasites and predators from ticks and bird lice to condors and man. So far as the terrestrial community is concerned, it is a vastly simplified one, reduced to a limited number of extremely distinct elements. It is this simplification that brings its problems within the range of effective scientific investigation, in striking contrast to the multiplicity and complexity of the life of such a faunal region as a temperate or tropical forest. We need only point to the entire absence of flowering plants from the guano islands to illustrate the extreme nature of this ecological simplification.

Birds by the Millions

An obvious set of biological interests centers on the behavior of the birds: the factors which bring them to the islands, which lead them to select certain preferred areas on the islands, which initiate courtship and nesting, which govern their dispersal and migrations, and, of course, which control the relations between the several species. To northerners, familiar with the flock concept from gregarious and

Gannets are characteristic of the more precipitous cliffs of the Chincha Islands.

migrating birds, it is something of a shock to see a single "flock" of birds not in migration extending from horizon to horizon, its numbers ranging from perhaps 100,000 to as much as 1,000,000. The number of birds nesting on a single island, less than a mile in diameter, has been carefully estimated as amounting to more than 5,000,000.

It is immediately obvious that the basic zoological interest in the identification of these birds and their associates as to their *species* is a simple one, long since adequately and correctly accomplished. While exhibition groups representing them are to be desired in any museum, we are no longer interested in preparing specimens of these creatures for museum reference collections. The interest of the guano islands and their bird populations lies in their *ecology,* the modern study of animals and plants in nature, whose basic concept of the interrelation of organisms involves not only the species concept but that of the family, flock, and community.

Long ago a lecture by Dr. Robert Cushman Murphy, of the American Museum of Natural History, on the "Bird Islands of Peru" gave me a first insight into their biological interest. A visit to the Galapagos Islands with the Crane Pacific Expedition for the Field Museum in 1929 brought me into personal contact with the problems of the Humboldt Current. It may be imagined how much I welcomed the invitation of William Vogt to spend a few days with him on North Chincha Island during my stay in Peru in 1939 during the course of the Field Museum's Magellanic Expedition. Mr. Vogt is now biologist for the Compania Administradora del Guano, which, as a private company

with a government controlling interest, administers the entire guano production of Peru. With its history of acceptance of advice from biological investigators, the guano company sets an extraordinarily successful example of far-sighted and practical conservation. Having once squandered a heritage from the past, Peru proposes *not* to squander its remaining annual income. When Dr. Coker first went to Peru to study the guano problem, there was much unnecessary disturbance of the nesting birds, whose low nests are entirely constructed of guano, since the collection of the product went on during the breeding season. Guano is now collected after the nesting season, and in alternate years, and Mr. Vogt's studies are necessarily directed toward less immediately obvious improvements in the management of the islands.

Contrast with Former Days

The Chincha Islands are reached from the cotton shipping port of Pisco, which is a few hours' trip south by automobile from Lima. Arriving at Pisco, one takes a taxicab to the company shipyard, a few miles farther south, where barges are built for the transport of guano. With proper arrangements made, one may then take the company launch to the headquarters on North Chincha, a three hours' run over a relatively smooth sea. New concrete buildings, erected by the company in 1939 to house and care for the workers during the guano collecting season, loom up from a great distance. They seem little short of palatial when one remembers the gruesome stories of the

Giant fulmar and Cape pigeons. The latter take their name from the Cape of Good Hope, and are veritable markers of the Humboldt Current, whose cold waters enable this species to reach the coast of Peru.

A pelican landing on Chincha Norte.

eighteen-fifties, when the bodies of Chinese coolies, worked to death under the whips of slave drivers, were all but loaded into the holds of the ships with the guano.

As we approach more closely, a low frame building, with a long veranda, set only a little back from the sea-cliff, comes into view. This provides quarters and laboratory space for visitors and scientists. As one lands at the hanging gangway, hundreds of beautiful Inca terns, coming from an adjacent wave-cut cave, wheel and cry about one's head. Then there is a warm welcome from Mr. and Mrs. Vogt,* and we sit down to a pleasant meal, perhaps with some dish of sea-food gathered from the Chincha rocks.

At the time of my visit the guano birds were at the very beginning of the nesting season, their nest-sites not yet established, only a small part of the full numbers of birds present. It was essential not to disturb the birds at this stage, but we could watch the evening flights come in, could see the growing patches of black cormorants on the white rock, perhaps enclosing islands of gray pelicans, and by day could see the established rookeries of boobies. These three are the principal guano producing birds, the cormorants ("guanays" in Peruvian) being by far the most important. On another island, reached by rowboat, the nesting aggregation was in full swing, and the cormorants came in during the whole day, clothing the island with a black mat of birds. On this island they nest so densely on the roofs

*The reader may wish to read Mrs. Vogt's charming account of the "White Islands" in the *Atlantic Monthly* for September, 1940.

of the care-takers' buildings that these roofs alone produce several tons of guano each year.

Lizards are Useful

The common lizards of the guano islands belong to the iguanid species *Tropidurus peruvianus*. This lizard ranges along the whole of the desert coast of Peru and northern Chile, with an extraordinary ribbon of dense population along the strand line. The large and brightly colored males seem to be disproportionately few in this species, and a special problem is presented by the presence of a brilliant orange or yellow flash mark on the groin in juvenile males. The lizards appear to have some importance in the life of the guano birds since they feed largely on the destructive bird ticks. Mr. Vogt has a simple but ingenious plan for increasing the population of the lizards on the islands by providing boards with a few cleats on the under-side for cover. The lizards near the laboratory buildings immediately adopted these shelters. Their use makes possible a study of the interesting behavior of these lizards—their fighting, courtship, and feeding activities. It is to be regretted that some student of animal behavior from a North American university cannot be attached to the guano company's establishment to pursue such studies both of birds and lizards under Mr. Vogt's direction. It is quite likely that he will undertake some observation of this kind himself.

The plans of the Magellanic Expedition required the presence of the main party at the extreme southern tip of South America for the brief Antarctic summer; and it was my duty to return to the museum. Conversations with the Vogts about our mutual interests in Peruvian geography and about plans for the further zoological exploration of the coastal desert, of the great Andean ranges with their stupendous valleys, and of the trans-Andean "montaña" (the tropical forest of the upper Amazon) were all too short. We could not hope for their resumption in a more peaceful or more stimulating setting than the quiet veranda above the wave-beaten sea cliff of Chincha Norte.

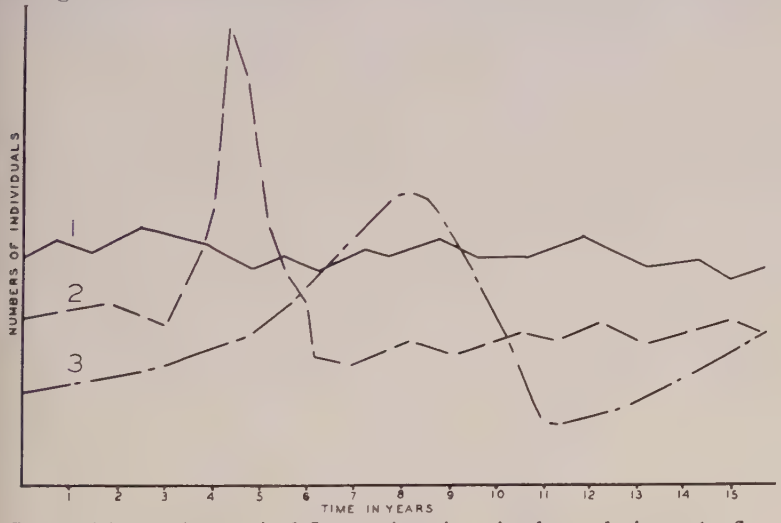
Natural History Quiz

The air lanes are crowded these days with quiz programs of all sorts and, because of the evident popularity of this stimulating form of entertainment, we have prepared a natural history quiz which appears on page 124 of this issue. Readers are invited to comment on this feature and to suggest questions for future numbers.

Animal Populations and Sunspot Cycles

Donald M. Hatfield*

For centuries it has been recognized that some species of animals at times occur in such abundance as to become serious pests, and at other times are so reduced in numbers that they can scarcely be found anywhere. It is only during the last two decades that any really intensive study has been made of the mechanics and causes of these fluctuations. Most of the work has been done in North America; first, under the impetus provided by a more widespread interest in hunting game birds, and second, following an awakening awareness that the behavior of animal populations constitutes a largely unexplored frontier —one which may quite possibly lead us to a better understanding of some of the problems involving human populations and to methods of solving them.



Curves illustrating typical fluctuations in animal populations: 1—flat; 2—irruptive; 3—cyclic (see text).

There are three general types of population fluctuations to be noted: the flat, the irruptive, and the cyclic (see figure). The flat type is undergone by the great majority of animals; the minor, year-to-year variations in numbers of individuals may be due to any number of factors, such as more or less food, better or poorer breeding conditions, better or poorer cover, etc. Such variations are localized and entirely irregular; the total number of individuals of the species involved tends to remain relatively constant over an indefinite period of time; i.e., it maintains a "balance."

*Curator of Mammals, Chicago Academy of Sciences.

The irruptive type of fluctuation is perhaps best exemplified by the bobwhite quail *(Colinus virginianus)* in the northern parts of its range. Here (in southern Minnesota and Wisconsin) the species exhibits the flat type of variation for a seemingly indefinite period; then, in the short span of a year or two, it increases nearly to plague proportions. Almost immediately thereafter there begins a comparable decrease in numbers, the population dropping to normal or slightly below. In a few instances it appears that the irruptive behavior is superimposed on a regular cycle of the type described below. This has been true of meadow mice *(Microtus* sp.) in at least two places in the Western United States: Humboldt Valley in Nevada and the valley of the Kern River in California. The cause or causes of such violent fluctuations are but imperfectly understood; it has been postulated that they result from an increased food supply, or that the food supply suddenly increases in nutritional value per unit. Also it has been guessed that they may be due to increased fecundity, or to a reduction in the number of predators. In any event, it is safe to assume that the increase is due to the partial or complete elimination of one or more of the factors normally acting as a check on the species. In passing, it might be mentioned that the tale of the Pied Piper of Hamelin and his feat is probably based on the occurrence of irruptive fluctuations in some of the rodents of Europe.

The cyclic type of population behavior is characterized by a rhythmic change in numbers of individuals; the cycle varies in length from four years to eleven or twelve years. The rise, as indicated in the figure, is typically gradual, extending over approximately two-thirds or three-fourths of the time required to complete the cycle. The subsequent die-off occurs more rapidly, and usually results in a loss of seventy-five to ninety-five per cent of the peak or maximum population. In general, the action might be compared to that of a roller-coaster, climbing slowly to a summit and dropping down the other side, only to reach a low point and begin the long climb to the summit of another incline.

The species experiencing cyclic population changes seem to be almost entirely confined to the Northern Hemisphere, although Hudson (1892) mentions cycles in Southern Hemisphere rodents, and recent experiences of collectors from the Field Museum of Natural History, working in Tierra del Fuego and parts of the South American mainland, indicate that certain rodent species may undergo pronounced cyclic fluctuation in those areas.

By and large, the number of species exhibiting cyclic behavior increases as one proceeds northward in the Northern Hemisphere. This is true throughout the temperate regions, and in the Arctic, where there are markedly fewer species, the fluctuations reach their greatest

extent, both in spread and in violence. It might be noted here that latitude seems to play a prominent role in determining cyclic behavior, even within a species. The bobwhite quail, for instance, is somewhat cyclic at the northern limit of its range (in the Lake States), while farther south its populations are relatively stable. However, it may well be that this apparent influence of latitude is in reality an expression of the increasing "unfitness" of the range of a species for the individuals of that species as one proceeds toward the edge or periphery of the range; i. e., as the absolute limit of tolerance of the species for its environment is approached.

Of the animals undergoing cycles in North America, perhaps the ruffed grouse *(Bonasa umbellus)* and the snowshoe hare *(Lepus americanus)* are the most widely known for this characteristic, and certainly the two have been objects of the most intensive study. Outstanding in this regard has been the work of King (1937) on the ruffed grouse, and the work of MacLulich (1937) in Canada, and of Green and Evans (1940) in the United States on the snowshoe hare. Other species whose populations vary cyclically include the following: the meadow mouse *(Microtus* sp.), the Canada lynx *(Lynx canadensis)*, the timber wolf *(Canis lupus)*, the red fox *(Vulpes fulva)*, the Arctic fox *(Alopex lagopus)*, the pine marten *(Martes americana)*, and the fisher *(Martes pennanti)*. Clements and Shelford (1939, p. 185) infer that the deer of the Kaibab Forest in Northern Arizona are cyclic; one cannot but view the inference with skepticism, for the reason that deer are not known to be cyclic elsewhere, and because there is no proof, observational or otherwise, that such a cycle exists.

Among the birds, the Lagopidae or grouse family seems more widely influenced by cyclic variation than does any other family of North American birds. In addition to the ruffed grouse, the pinnated grouse *(Tympanuchus cupido)*, the sharptail grouse *(Pedioecetes phasianellus)*, the spruce hen *(Canachites canadensis)*, the blue grouse *(Dendragapus obscurus)*, and the ptarmigan *(Lagopus lagopus)* all appear to be definitely cyclic. Among the fish, the salmon has also been found to show regular periodic fluctuations in numbers.

Early in the study of cycles it became apparent that there was need for accurate statistical data concerning the fluctuations over a relatively wide area in order that local variations might not obscure the wider fluctuation affecting the whole region—so that we might see the woods despite the trees. The fur reports of Hudson's Bay Company seemed to furnish exactly the material needed, since they extended back for more than a century, and since they recorded the results of fur-trapping over almost the whole of Canada. It is not surprising, then, that most of the early work on the problem resolved itself into an analysis of these reports and, as will be shown later, they

are still being subjected to considerable close scrutiny.

Under detailed study, these records revealed that the cycles among the fur bearers show a periodicity of around nine to eleven years, but not simultaneously over the whole of Canada. It appears that the cycles travel in waves across the continent from the west to the east; a species reaches its peak, followed by a die-off, first in the western provinces, next in the prairie provinces, and finally in the middle and eastern provinces. It has since been found that most cyclic species show a periodicity of approximately eleven years, while some, principally among the rodents, reach maxima every four or five years.

Cycles have been attributed to many causes, from predation on up. It appears, however, that they may be divided into two principal categories—disease and sunspots. Up to the present time, we have no definite proof that either is the chief cause but, as will be pointed out later, projects under way now may go a long way in answering the question within a few years.

Sunspot cycles have been recognized for a long time, and attempts have been made, at one time or another, to correlate with them almost every phase of climatic variation, human activity, and plant and lower animal behavior. At first thought, of course, it seems somewhat absurd that "spots" on the sun, about 93 million miles distant from the earth, could have any appreciable effect upon, for instance, the snowshoe hare in North America. However, the sunspots undergo a cyclic increase and decrease with a periodicity of eleven years! Perhaps this time similarity between animal cycles and sunspot cycles is merely coincidence, and perhaps not. It will be noted that the species affected by cyclic fluctuation may be divided into two groups: those that obtain their food directly from plants, and principally from the tender terminal portions of the plants; and those that feed on these plant-eating species. Now, if there is a drastic reduction in the numbers of a plant-eating (herbivorous) species, it is inevitable that there will also be a comparable reduction in the numbers of meat-eaters (carnivores) feeding upon them. The latter will starve simply because there is not enough prey to go around. It seems logical, then, to look to the herbivores—the rodents, the hares, and the grouse—for an explanation of the causes of cycles, inasmuch as they constitute the first step in the "chain."

During the maximum of the sunspot cycle, i. e., when the surface of the sun bears the greatest number of "spots," the proportion of ultra-violet rays in the sunlight reaching the earth is higher than at other times. It is known that a high proportion of ultra-violet light has a retarding effect on plant growth. It has also been ascertained that during the years of sunspot maxima, more inclement weather occurs than at other times. With less food available, even by a little

(due to retarded plant growth) and with less favorable weather conditions prevailing at these times, it appears reasonable to assume that the herbivores—especially those feeding on the tender green portions of the plants—would suffer, both through direct starvation and, less obviously, through a general weakening of the population because of malnutrition. Poorly-fed individuals succumb more readily to the effects of parasites and disease than do well-fed ones; hence a population, beset by a lowered food supply and an increasing vulnerability to disease, is inevitably reduced. This reduction is, then, one of the factors which act to prevent an unrestrained increase in species which otherwise might conceivably increase indefinitely.

This theory (and please remember that it is only a theory) is subject to several severe criticisms. In the first place, it is apparent from the records that the cycle does not act simultaneously throughout a species, even in a relatively small area. Thus Cross (1940), working in Ontario, and analyzing the Hudson's Bay Company reports of 1916 through 1938 in that province, has shown that the red fox, although subject to apparently widespread cyclic fluctuation, with "lows" in 1920 and 1931 and "highs" in 1917, 1926, and 1936, in reality rather was experiencing local changes in numbers resulting from "changing local conditions." It is difficult to ascertain whether or not he has lost sight of the woods because of the proximity of the trees. However, on the basis of his results, Cross states that ". . . fluctuations in the numbers of the fox in Ontario are definitely not correlated with sunspots. . . ." The proponents of the sunspot theory are given further pause by the work of MacLulich *(op. cit.)* who, after studying the records for the snowshoe hare and the Canada lynx, concluded that the fluctuations of neither are correlated with sunspots.

There the matter rests at present. The opposition has stated its case, and the burden of proof would seem to lie with the affirmative. It is expected that the Canadian Snowshoe Hare Inquiry, being conducted in Canada, Northern United States, and Alaska, may throw more light on the problem. Starting with 1933, information has been gathered annually from competent observers throughout these areas concerning the numbers of hares seen, the type of cover in which they were seen, etc. It has been assembled and tabulated by C. S. Elton in England. It was expected that the project would extend through a 10-year period; whether the war will force its abandonment remains to be seen.

Outstanding among the investigations into the role of disease in cyclic fluctuation has been the work of Green and Evans *(op. cit.)* Starting in 1932, these men have been studying the incidence of disease in snowshoe hares on a control area near Lake Alexander, in Morrison County, Minnesota. Their procedure—live-trapping hares, ear-tagging and releasing the majority for possible later recapture—

has yielded much information other than that strictly concerned with disease. For instance, by a process of calculation, they produce census data which actually show the cyclic trend in detail. Thus, there was a population of approximately 478 hares per square mile on the area in 1932-1933; this had dropped, by 1937-1938, to a population of only 32 hares per square mile. In 1938-1939, the number per square mile had risen to 73, so apparently the hare has started up the incline again in this area.

At first, these workers, and others engaged in disease investigation among wild animals, concentrated on tularemia or "rabbit fever," with the supposition that it might be the immediate cause of cyclic decimation. However, this idea has of late been discarded in favor of "shock disease," an ailment having to do with the functioning of the liver and associated organs. The presence of such a disease and its immediate influence in bringing about the cyclic decline do not, however, seem to relieve us of the necessity for finding some basic cause—a cause which causes the disease!

To my mind, one of the most important contributions made by these workers in this study concerns the effect of the cycle on the various age groups of hares. They arrive at the conclusion that the cycle has little or no effect on animals more than nine months of age, that practically all the loss attributable to the effect of the cycle occurs before nine months. If this is true, and their calculations seem adequately to prove that it is, then our search is narrowed down considerably.

It is obvious from the above brief account that, although we are beginning to understand some of the factors influencing fluctuations in animal populations, we are still a long way from understanding the basic causes underlying these fluctuations. Many more years of intensive, widespread work will be required before we may safely say, "Cycles are caused by . . . ."

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In Saguaro Land

An account of the Offield-Beaty Expedition of the Chicago Academy of Sciences May-June, 1940

Howard K. Gloyd

(Continued from Number 3, p. 78)

Amphibians

In spite of the obvious restrictions on the distribution and activities of frogs and toads due to the relative scarcity of water, the desert supports an amphibian fauna. Although our stay at the Arboretum was in advance of the summer rains, we obtained a fair sample of the species expected to occur there. Spotted frogs *(Rana pipiens)* and Rocky Mountain toads *(Bufo woodhousii)* were singing at night in the Arboretum lake and tadpoles, presumably of these species, were abundant in the lake and in the pools of Arnett Cañon. The Sonoran tree-frog *(Hyla arenicolor)* was heard occasionally but its breeding season appeared to have passed. Specimens were collected on boulders in the cañon and in a water tank above Picket Post House. The red-spotted toad *(Bufo punctatus)* and the giant toad *(Bufo alvarius)* were prowling at night along the paths among the irrigated areas of the Arboretum.

An Unfamiliar Voice

Although I had collected giant toads in Arizona ten years before, none of them had been singing and I was quite unprepared for the surprise which resulted when their voice was identified. On the last night of our stay at the Arboretum, while I was driving slowly along the highway watching for snakes, my ear caught the voice of a frog or toad from a nearby ditch. It was a medium-pitched, rolling cry, not unlike that of some of the tree frogs in quality, not very loud, and repeated at intervals of three or four seconds. My flashlight revealed a strip of shallow water, about twelve feet wide and a hundred and fifty feet long, which may have escaped from an irrigation ditch. Sweeping the banks to the right and left with the beam of light and seeing no reflections from amphibian eyes, I concluded that the "tree-frogs" were hiding in the low bushes which, in places, bordered the ditch. When voices close at hand ceased, as the songs of hylas often do, I paused quietly with light shut off and ears straining to locate the source of the sound when they resumed.

"Wur-r-r-r-úp," it came again; ahead and to the left—but how far? I wished for a companion who could help find the spot by simple triangulation. Creeping forward cautiously, I examined every bush from several directions following with the light each stem and each tangle of branches that might conceal a tree-frog. Continuing this search until the calls in front of me stopped completely, I reached the end of the water.

"Wur-r-r-r-úp! Wur-r-r-r-úp!" Behind me now. Retracing my steps, I noted with renewed hope that one not far away continued to sing and that I was actually getting closer. The nearby voice stopped but others at the far ends of the stretch of water continued. The swinging beam of light fell upon a pair of large eyes that sent back a soft yellow glow from the opposite side of the ditch. There on the bank in smug obesity sat a large toad which I recognized as *Bufo alvarius*.

"You pompous, pot-bellied so and so," I muttered; "I'll be over there to get you as soon as I find this blasted hyla!"

Fatuously I renewed the search in the bushes and on the banks for the small frogs which my imagination had created to fit these quavering voices.

"Wur-r-r-r-úp," came the cry again behind me. Angry in my frustration I swung about. The light fell upon the fat toad on the bank and while I stared in astonishment he straightened his elbows and, as his throat swelled, gave voice to a sniggering "Wur-r-r-r-úp"—a derisive jeer at my stupidity.

Moving quietly no longer, I waded across and soon had him in the bag. In a moment another pair of bulbous eyes and a large green head rose to the surface a few feet away, and a little later another. In the

course of half an hour I had twelve. All except the one which had given me the bufonian version of a Bronx cheer were in the water. They came to the surface, took a deep breath, expelled it with an attenuated "burp," and then paddled on to another spot. They traveled under water for considerable distances but did not stay long beneath the surface. Since all that were captured appeared to be males, this aggregation may have been only the beginning of a "breeding chorus." No females were found in the vicinity of the ditch.

Relatively little is known of the habits of the giant toad. One of the largest North American species, it is found only in the deserts of the extreme Southwest. Although it can be handled, apparently, without ill effects, its skin secretions under some circumstances are decidedly poisonous. An interesting case has been reported* in which a small fox terrier died within a few minutes after attacking one of these toads; and a police dog, having touched with his nose the toad killed by the terrier, suffered temporary paralysis.

Donald Lowrie and Earl Wright extract a small chuckwalla from a crevice.

Lizards Were Always With Us

Lizards of several species were abundant at the Arboretum. On the sides of buildings, on the lath houses, and on the cañon walls we met the little tree utas *(Uta ornata)* at every turn. They were companionable little chaps, full of apparent curiosity toward us, and industrious

*Musgrave, *Copeia*, no. 173, 1930, p. 96.

in stalking their insect prey. When flashing their sky-blue throats and sides to intimidate their rivals in courtship, the males gave an impressive, although diminutive, display of grandeur to which we sometimes felt like responding with applause. Probably as abundant but more shy were the brown-shouldered utas *(Uta stansburiana stejnegeri)*. They were seen on the ground or among rocks, especially in the more open cañons where they frequently watched us from the tops of small boulders, dodging out of sight if we came too near. The band-tailed earless lizards *(Holbrookia texana)* occurred in the same situations. When startled they waved their black-banded tails above their backs like excited puppies. The larger gridiron-tailed lizards *(Callisaurus ventralis)*, which were more common in the sandy arroyos, also have this habit.

Chuckwallas *(Sauromalus obesus)*, large flat-bodied denizens of the rocks, were never far from sheltering crevices in which, by inflating their lungs, they wedged themselves so tightly that they were extremely difficult to extricate. Even if seized by their sturdy tails, which do not break as easily as in most lizards, they often resisted capture. One patriarchal male had lost about half of his tail; the wound had healed but a bony stub protruded beyond the skin. Had he encountered an ambitious collector, we wondered, or was this the work of some natural enemy?

Abundant on the floor of the cañons and desert but less often found in the hills were the slender, black-chested whip-tailed lizards or "racerunners" *(Cnemidophorus tessellatus melanostethus)*. Constantly on the move, they traveled in and out through the clumped bushes, picking up insects encountered en route. When approached quietly they showed little fear and continued their normal activities, but if startled they were off like a streak, sometimes taking shelter in holes in the ground when hard pressed. Rarely one was seen clambering among the rocks on the side of a cañon.

The poisonous Gila monster *(Heloderma suspectum)*, common farther south in the state, was apparently rare in the vicinity of Superior. The first in several years was caught in the Arboretum shortly before we arrived. It was photographed by several people and then liberated in a spot seldom frequented by visitors.

Pneumatic Nimrods

Several months before our trip to Arizona, someone brought to the Academy one evening a hand-made imitation of the long-famous blowgun of South American Indians. In the skilled hands of aboriginal experts a lusty puff of air through one of these simple but fearful tubes sends a drug-tipped dart into the flesh of enemies or game animals with lethal results. The gadget was intriguing to the Wright brothers, both skilled marksmen with pistol and bow, and they immediately pro-

duced "improved models" of both blow-gun and dart. Target shooting with these windy weapons furnished considerable amusement during informal moments at subsequent meetings of the Kennicott Club. Competition flourished and skill improved. Some weeks later the skull of a rat—pierced through the "interorbital foramen" by a blow-gun dart—was proudly exhibited, and the credulity of those of us who are Missourians at heart was severely taxed.

Unimpressed by the potentialities of these custom-built, super-deluxe models of a primitive air rifle, I looked askance at the two which appeared among the paraphernalia unpacked in the Arboretum laboratory. As it happened, my aspersive thoughts had to be retracted for by this means the collection of reptiles was unexpectedly augmented. Several specimens of hard-to-get lizards, and even a snake, were silently shot by the blow-gun during odd moments near the Arboretum buildings where usual methods of collecting were impractical or *verboten*. Our party does not wish to go on record, however, as exponents of the art of wind-jamming as a standard method of collecting scientific specimens.

In Quest of Serpents

Much has been said concerning the abundance of snakes in the deserts and mountains of the Southwest, but the herpetologist who fails to discount such remarks before setting out in quest of these reptiles is likely to be disappointed. It is true that this region contains a great variety of ophidian species and occasionally—depending upon such factors as season, temperature, time of day, and the amount of recent rainfall—there is an evident abundance of individuals. Snakes *may* be seen almost any time or anywhere and certain localities acquire, through the years, a reputation in the minds of local people for being especially "snaky." The collector, however, usually finds that such areas fail to come up to expectations. Perhaps people who recommend that he hunt in a certain place have in mind only the visits on which they have found snakes and fail to remember the times—perhaps even more numerous—when they have seen no snakes at all.

We found the vicinity of Superior and the Arboretum neither more nor less abounding in snakes than could be expected in any other similar region under similar conditions. Such diurnal species as the whip snakes (*Coluber flagellum frenatum* and *C. semilineatus*), the garter snakes (*Thamnophis eques* is perhaps the most common)—locally called "water snakes," the gopher snakes or "bull snakes" (*Pituophis sayi affinis*), and the patch-nosed snake (*Salvadora hexalepis*) which is somewhat crepuscular, turned up at frequent intervals. One large gopher snake, a special pet of the Arboretum staff, was "caught" about every third day. For a time we kept him on the porch

of the guest house as a companion for "Elmer, II," a lethargic, poker-faced desert tortoise (*Gopherus agassizii*), our apathetic mascot who remained completely indifferent to all overtures of friendship.

The western diamond rattlesnake (*Crotalus atrox*) is the only species of rattler common in the area. Three were caught at the Arboretum and two in other localities not far away. In a cañon west of Picket Post Mountain, Donald Lowrie discovered a large black-tailed rattlesnake (*Crotalus molossus*) quietly resting in a crevice. Excessive exposure to the sun while being photographed a few days later caused the death of this snake. Through the kindness of W. A. Bevan, a herpetologist from California who visited us for a few days, we obtained a tiger rattlesnake (*Crotalus tigris*), a comparatively rare species with a restricted range in Arizona and northwestern Mexico.

Night Collecting

Until a few years ago several kinds of burrowing snakes were collected only by sheer accident, and so few specimens found their way into collections that the species were considered extremely rare. About ten years ago, however, herpetologists in the Southwest began to appreciate the possibilities of collecting nocturnal reptiles on desert highways by means of the automobile and its headlights. The method, now developed into a highly effective system by L. M. Klauber and his associates at San Diego, California,* consists essentially of driving slowly on paved roads and watching for snakes, and other animals, revealed by the lights of the car. Results depend upon many variable factors such as season, time of day, temperature of air and ground, humidity, nature of the adjacent territory, etc. Of these factors, temperature is one of the most important and, according to Klauber, the optimum air temperature seems to be between 80° and 86° F.

During the latter part of May and early June we "worked the roads" of the desert west of Superior almost every night. In general, this type of collecting did not yield as much as on previous occasions. The reptile most commonly found was the banded gecko (*Coleonyx variegatus*), a small, harmless lizard with a fleshy tail, nearly transparent skin, and eyes with slit-like, vertical pupils. Among the snakes were young gopher snakes (*Pituophis sayi affinis*), the "faded snake" (*Arizona elegans*), a king snake (*Lampropeltis getulus yumensis*), the spade-nosed snake (*Sonora occipitalis*), and two species of leaf-nosed snakes. The desert leaf-nosed snake (*Phyllorhynchus decurtatus*) was fairly common but we found only two specimens of the Maricopa leaf-nosed snake (*Phyllorhynchus browni lucidus*), a little-known

*For a historical and statistical account, see Klauber, Studies of Reptile Life in the Arid Southwest, Bull. Zool. Soc. San Diego, No. 14, 1939; part 1, Night Collecting on the Desert with Ecological Statistics, p. 7-64.

The Maricopa leaf-nosed snake, a rare burrowing species collected at night.

form quite recently described (see figure) and hence a special prize.

Donald Lowrie spent many hours collecting spiders and nocturnal insects, "shining their eyes" by means of an electric headlight. This is an especially effective method, essential to the finding of many kinds of invertebrates that would be overlooked or impossible to find in the daytime. Nocturnal mammals such as the kangaroo rats and jumping mice may also be collected in this way but conditions were unfavorable, apparently, during our stay in the lowlands. Even in areas where they could logically be expected kangaroo rats were strangely scarce.

Pinal Mountain

As guests of Mr. and Mrs. Gibson our entire party spent a day on Pinal Mountain, some ten miles south of Globe. This "side trip" afforded opportunities for seeing, close at hand, the splendor of the highland forest of oaks and pines, and for collecting animals not found in the desert. Earl Wright made motion pictures of hummingbirds, chipmunks, and a gigantic aggregation of "lady-bug" beetles while the rest of us searched for specimens in our respective fields of interest. As the chilly mountain air descended on us in late afternoon we hustled into leather jackets, rekindled the fire, and disposed of the remaining coffee and hamburgers. Halfway down the mountain we paused to watch the sun retire—with coverlet and canopy of gold and crimson.

Although our activities naturally centered about the Arboretum and vicinity, we made numerous short trips to other localities of interest: the desert plain near Florence Junction, Queen Creek Cañon and Oak Flat above Superior, the hills and small cañons between Superior and Ray, and the southern base of Superstition Mountain. With W. C. Murphy of Superior, who has collected herpetological specimens for eastern museums, we visited the site of ancient Indian ruins between Superior and Miami and the old Silver King Mine in the hills north of Superior. Donald Lowrie and I spent a day collecting on the Apache Trail, passing Cañon Lake, Fish Creek Cañon, and Roosevelt Reservoir. Each of these minor excursions produced something of interest and value even if specific objectives sometimes were not realized.

We Move to Mount Graham

On June 3 we shipped our heavier paraphernalia by motor freight to Safford, loaded the remainder in the cars and, somewhat regretfully, left the scene of our delightful three-week sojurn in the desert foothills, and the cordial hospitality of the Gibsons and the Arboretum staff. Our destination was Mount Graham, the largest and highest of the Piñaleno Mountains in Graham County, southwest of the town of Safford. On the higher slopes of Mount Graham is a magnificent forest of ponderosa pine, Douglas fir, white fir, and aspen. The animal life is strikingly different, of course, from that of the desert.

Through the courtesy of Frank Grubb, District Supervisor, Crook National Forest, and Ranger C. V. Christensen, we were permitted to camp near the Columbine Ranger Station at an elevation of approximately 9500 feet. We pitched two tents and erected a canvas shelter under which to prepare specimens in case of rain.

The days were delightful but at night the temperature dropped below 40°; we needed all our bedding and could have used more. In some places the snow had scarcely melted; ferns and small herbaceous plants in the more shaded places were in their very young stages. At the edges of tiny meadows, where patches of yellow blossoms rejoiced in the passing of the snow, stood clumps of aspens, their pale new leaves lush and gentle against the stark and somber pines. Birds were abundant but nesting had scarcely begun. As for reptiles, we appeared to be three or four weeks "ahead of the season."

Conditions were not favorable for making motion pictures and the Wright brothers spent their time collecting and skinning birds and mammals. Donald Lowrie filled vials of alcohol with spiders and insects from different levels on the mountain slopes. With an optimism somewhat forced, I searched for reptiles in multifarious rock-piles and

Camp at Columbine, on Mount Graham.

seductive by-paths. I even looked in "snaky" places reported by road crews and—by the grace of whatever fate is kind to serpent catchers—actually found a rattlesnake. This particular species, the Arizona spotted rattlesnake (*Crotalus triseriatus pricei*), was a special objective on Mount Graham, for only two specimens from that region had been previously known to me. It is a small, docile species, gray in color with a double row of small brown spots, relatively little known because it lives at high elevations, the pine-clad ridges and slopes, of mountains in southeastern Arizona, Sonora, and Chihuahua.

We collected only one other snake on Mount Graham, a garter snake (*Thamnophis ordinoides vagrans*). Lizards were fairly abundant but they represented only one species (*Sceloporus jarrovii*) and seemed to have been out of hibernation only a short time, for the males had not yet shed their old epidermis and exposed the bright tones of blue that form such a conspicuous part of their nuptial coloration.

After a week among the pines and aspens we returned to Safford and the Wright brothers began the return journey in order to be in Chicago at the proper time for early summer field work in the Indiana Dunes. Before setting out toward our next objective, Donald Lowrie and I had a day of successful collecting at Jacobson's Creek on the northeastern slope of Mount Graham.

The Arizona spotted rattlesnake, restricted to mountain habitats in the Southwest.

In the Huachuca Mountains

If there is such a thing as a "classic" locality for naturalists in North America, the Huachuca Mountains fully merit such distinction. In the extreme southwestern corner of Cochise County, Arizona, with their southern foothills scarcely inside the International Boundary, these mountains have been visited repeatedly by botanical and zoological collectors since the boundary under the Treaty of 1853 was first surveyed. Although several other small mountain ranges in southern Arizona also mark the northern limits of typically Mexican elements of the flora and fauna, the Huachucas for various reasons have been most thoroughly studied.

Our visit to the Huachuca Mountains was made in the hope of photographing some of the lizards and snakes which seem to be most brilliantly colored in this region. Philip C. Bowman of Bisbee, who has sent numerous specimens to the Academy during recent years, cordially placed at our disposal his cabin in the upper end of Ramsey Cañon, between three and four miles by trail above the Bledsoe Ranch where the road ends. We left our car at the ranch and on a horse obtained from the caretaker (Phil Bowman's burrow, which we expected to use, having mysteriously strayed away from his customary habitat) we packed the minimum of food, cameras, and collecting equipment.

The trail around the steep-sided box cañon, through which the loaded horse could not be taken, ascends a steep slope, necessitating a climb of five or six hundred feet in the course of little more than half a mile, and then descends some three hundred feet to the side of the stream. From there on it follows the watercourse and, ascending steadily, passes the ruins of the old Hamburg Mine—crumbling log houses, a rusty boiler and compressor, and a gigantic "dump." About a mile farther on, at an elevation of 7300 feet, is "Pat Scott's place," another log ruin, and Bowman's cabin, known as "the green house." The cañon here is heavily forested, the trees chiefly pines and Douglas fir. At the time of our visit the creek contained little water and in some places ran beneath the rocks, leaving a superficial bed practically dry. The summer rains which we hoped for had not yet come. To some extent conditions in the Huachucas resembled those found in the Piñalenos: the region was dry, the nights were still cold, and relatively few reptiles were active. We were still too early.

Several favorable habitats for snakes, familiar to me since my first trip to the Huachucas ten years earlier (July, 1930) and a number of subsequent visits, were diligently investigated but yielded nothing. Many slopes were climbed and many "tons" of rock and debris were moved in vain search for the red king snake (*Lampropeltis pyromelana*), the green rock rattlesnake (*Crotalus lepidus klauberi*), and the bright yellow and black "mountain diamond-back" (*Crotalus molossus*) which are—or were!—common in these mountains.

Transportation of equipment in the Huachuca Mountains.

On the several previous visits to Ramsey Cañon I hoped especially to find a specimen of Willard's rattlesnake (*Crotalus willardi*), a very remarkable and rare species first made known to science in 1905 from a specimen probably collected near the Hamburg Mine. Since that time, six or seven additional specimens have been taken in the same area by as many different collectors. In each case the snake was found "in the open" or "crossing the trail," and no information has become available as to what kind of shelter these reptiles require. Consequently, the collector who seeks this species can only "look everywhere" and keep everlastingly at it. To date, my own efforts to collect this snake seem to have been under the auspices of an evil jinn. Literally, I think, I have spent more time and lost more pounds in pursuit of this herpetological will-o'-the-wisp than in hunting for any other single species. Why this particular jinx should attach itself to me I can not reason out; but I am not a philosopher.

On the third day after our arrival, Lowrie returned from a hike down the trail and, after reporting his success with spider collecting, nonchalantly produced a tightly tied cloth bag and inquired: "What will you give me for a *willardi?*"

"I am in the market for a *willardi,*" I answered dryly. Fearing a trap, I refused to warm up prematurely. He had me dangling, and knew it.

"Do they come in browns?" he asked, prolonging the suspension. I could stand it no longer. I snatched the bag, opened it, and looked down upon a small coil of velvety brown, a turned-up snout, a delicate "white enamel" line diagonally across a scaly cheek.

"Yes, *willardi* comes in browns, and this is it!" I exclaimed. *"Where* did you find it?"

"Right in the trail, near the Hamburg Mine," was the answer! Delighted as I was to have the snake—truly a thing of beauty if you appreciate ophidian pulchritude—I could not help muttering: "There ain't no justice."

In spite of the disappointments due to our arrival in advance of the summer rains, there were some delightful experiences which made our five days at "the green house" both enjoyable and profitable. Just below the cabin, where water from a spring kept the bed of the creek moist and encouraged a luxuriant growth of mosses, lichens, and other small plants, insects of great variety came in large numbers, attracted by the moisture. When the sun was high and sufficient light available, we set up the movie camera with the "big lens" and indulged in a photographic orgy, making pictures of butterflies, skippers, moths, dragon-flies, wasps, flies, bees, crane-flies, beetles, and spiders. Even caddis-fly larvae and planarian worms from beneath stones in the

Willard's rattlesnake, a rare snake collected in Ramsey Cañon.

tiny stream were successfully photographed. Birds also came to drink and, without a blind, pictures were made of a red-shafted flicker and of gray-headed juncos. Long-crested jays appeared at intervals but managed to keep a leafy branch or a bushy plant between themselves and the camera. A pair of band-tailed pigeons came down like plummets and drank almost at my feet. I crouched, motionless, beside the tripod, but at the first flick of a finger to turn the camera in their direction they were off like twin rockets. Dolefully I reproached myself for not being prepared with a blind—but I had not expected to photograph birds in the Huachucas.

Since we carried water from the spring for use at the cabin, the wet spot in the creek bed and the animals that visited it engaged our attention at frequent intervals. While waiting beside the movie camera one day, after exposing a few more feet of color film on the constantly changing procession of insect life, I had a brief glimpse of an unfamiliar bird in a dense thicket of young pines on the slope above. It came in with soft, silent wing-beats, perched an instant, gave a flip or two with its long, square-ended tail, and then moved on to pause again a short distance away. Before it disappeared in the dark tangle of pine branches, its short bill, its large round head with a broad light bar behind the eye, came clearly into view. With tingling pleasure I realized that for the first time I had just seen one of our rarest birds—the coppery-tailed trogon.

Later that evening Phil Bowman came up to the cabin and as the sun dropped behind the ridge, leaving the cañon in shadow, we sat, chatting, on the screened porch. From an oak tree near the creek there came a strange cry: "kah–kah–kah–kah–kah," it sounded! Surely a bird. Could it be . . . . ? Slipping quietly through the door, I moved toward the calls which continued in groups of five, separated by intervals of five or six seconds. My movements should have been more stealthy, for the bird flew before I could locate it among the branches. A short, yellow bill; a large, dark head; a long, square-ended tail; and a glimpse of crimson underparts—yes, a male trogon!

This gorgeous Mexican species has been known to occur in the Huachuca Mountains since 1885 but few zoologists have seen it and the State of Arizona does not permit it to be collected. What naturalist and photographer would not be thrilled by the opportunity to study and make pictures of this sub-tropical denizen of our own Southwest?

Next day we searched for possible nesting sites. A cavity in a dead oak stub looked promising but showed no signs of occupancy. The birds were neither seen nor heard again, and it was time for us to leave. Wistfully, we thought, "Perhaps another time . . . ."

Our last night at "the green house" was especially enjoyable. Phil Bowman had brought up a big steak which, after several days of food chiefly out of cans, was heartily welcomed. We stoked the wood stove and listened appreciatively while Phil regaled us at length with the story of "the lost Adams diggin's," a saga of gold and blood, of Red men and dead men. Next day the horse was again requisitioned to carry our paraphernalia down the now familiar trail to the automobile which was to bring us back to striking clocks, the daily shave, traffic tangles, and city "smog."

Test Your Nature Lore

Are these statements true or false?

1. The cross fox is so-called because it arose from crossing the gray with the red fox.
2. The beaver is the largest rodent to be found in the world.
3. It is possible to distinguish between the footprints of a dog and those of a coyote.
4. The porcupine is born with well-developed quills.
5. Woodchucks frequently climb trees.
6. Lemmings are not found in North America.
7. Anal scent glands are present in the badger.
8. Young deer carry their antlers longer than old deer.
9. Storage of fat in the autumn is characteristic only of those animals which hibernate.
10. The European hedgehog belongs to the same family as our Canada porcupine.

Answers on page 127

MUSEUM ACTIVITIES

Sunday Afternoon Lectures at the Academy.

The following lectures, free to the public at three o'clock on Sunday afternoons, are announced for the months of January, February, and March. The doors of the Auditorium are opened at 2:45 and closed at 3:00 or before if the hall is filled. A section is reserved for members until three o'clock.

Jan. 5: **North of the Tree Line,** Dr. Harry L. Andrews, Zoology Department, Herzl Junior College. During the summer of 1939, Dr. Andrews was a member of a party of scientists who visited the tundra of northeastern Manitoba along the shores of Hudson Bay under the leadership of Professor V. E. Shelford of the University of Illinois. His kodachrome movies show interesting features of the plant and animal life of this treeless land of the North.

Jan. 12: **Mysterious Jungle,** Harold D. Fish, Chicago Medical School. Harold D. Fish, well-known scientist, educator, conservationist, traveler, explorer, and student of world affairs, gives two lectures on the jungle of British Guiana. He was director of the Jungle Laboratories of Tropical Biology at Kartabo, British Guiana, and his first lecture deals with the plants and animals found in the vicinity of the laboratory. To most of us, South America is just a map. Mr. Fish tells of its extensive forests, its swift and mighty streams, and its primitive people.

Jan. 19: **Old Ghost Falls,** Harold D. Fish, Chicago Medical School. Kaietur —Indian word meaning "Old Ghost Falls"—is one of the highest waterfalls in the world; a sheer drop of 741 feet, with the water shooting back into the air higher than the top of Niagara, far in the depths of the jungle of British Guiana. While seeking a better site for a jungle laboratory, Mr. Fish went to this wonderland by canoe. The beauty of the stream and shore, the change of light and shadow, were recorded photographically throughout the trip. These pictures have caught the spirit of the tropical wilderness.

Jan. 26: **Local and Southern Gardens,** Dr. C. O. Schneider, Chicago. The beauties of some of the North Shore gardens have been wonderfully preserved in natural color photographs by Dr. Schneider. In addition to these local beauty spots, pictures of the famous Bellingrath Gardens, Mobile, Alabama, and the Magnolia Gardens of Charleston, South Carolina, bring exquisite floral wonders from a section of the country which is deservedly proud of its gardens.

Feb. 2: **Ceramics—Illinois' Most Ancient and Indispensable Industry,** Professor C. W. Parmelee, Department of Ceramic Engineering, University of Illinois. Professor Parmelee is well qualified to speak on ceramics, the science which deals with making from clay such things as pottery, chinaware, and tiles. A leading figure in his branch of science and a past president of the American Ceramic Society, he discusses the nature and importance of the ceramic industry in the economic and scientific development of the State. Illinois contains great resources of coal and oil, an abundance of valuable clays, shales and sands. The State has a large population, and, for

the utilization and distribution of ceramic materials and products, is strategically situated.

Feb. 9: **Recent Advances in Our Knowledge of Sleep,** Dr. Nathaniel Kleitman, Department of Physiology, University of Chicago. It is always a privilege to hear a leader in any branch of scientific research present the latest findings in his own field. Dr. Kleitman is a physiologist who has recently won renown for his extensive studies on the problem of sleep. A large portion of our knowledge of the processes involved in sleep and the complex mechanisms which control it, has been the direct result of the work of Dr. Kleitman and his associates. His lecture describes recent observations and experiments on the physiology of sleep and their important implications.

Feb. 16: **Silurian Studies in Southern States,** Dr. John R. Ball, Department of Geology, Northwestern University. In present day seas there are fascinating aspects of the distribution of life: the coral reefs, fishing banks, the so-called "death traps" and "gardens"—all with problems of great interest to the modern biologist. In the remote Silurian seas of 350,000,000 years ago there were similar areas and their comparable problems now challenge the paleontologist. The location of some of these Silurian points of interest is one of the objectives of Dr. Ball's researches. His lecture deals with human experiences as well as scientific aspects of work of this nature.

Feb. 23: **Patterns of Negro Music,** Dr. Melville J. Herskovits, Department of Anthropology, Northwestern University. Among anthropologists, Professor Herskovits is the recognized authority on the American negro. In following the many problems which such a race presents he has studied the negro in the United States, in Africa, in the islands of the West Indies, and in South America. One of the most astonishing angles of his work has been the tracing of negro folk music from its origin in West Africa, through the West Indies to our southern states, and finally to the "boogie-woogie" swing music of today. He has made recordings of the folk music in these various regions and will "illustrate" his lecture with records.

Mar. 2: **New England Mountains in Autumn,** Dr. Louis J. Tint, Chicago. New England mountains in the fall, the gold and crimson of autumn foliage against a background of the ageless beauty and splendor of the Green Mountains, the Berkshires, and the Adirondacks! Dr. Tint made this new series of natural color photographs last fall, and through his artistry we may again enjoy the wonders which are always to be found in nature.

Atwood Celestial Sphere Used by U. S. Navy

Arrangements have been completed whereby the U. S. Naval Reserve Unit, stationed at Abbott Hall on the Chicago Campus of Northwestern University, will make use of the Atwood Celestial Sphere in training men in the principles of navigation. Lieutenant Commander Clarence Williams, U. S. N., in charge of the navigation department of the training unit, has been working with Dr. Williams on the problem of adapting the sphere to this new use.

Designed by Wallace W. Atwood, former executive secretary of the Academy and now president of Clark University, the sphere was built in 1913 through the generosity of LaVerne Noyes. When erected it was the only apparatus in the world which demonstrated the heavens in a more or less natural manner. Since then the Zeiss Planetarium has been developed and its wonderful mechanism makes possible the reproduction of the heavens in any region of the world and for any period in time. The Atwood Sphere shows the stars over Chicago for any season of the year, but does not give the planets. It is a hollow shell of thin metal, 15 feet in diameter, within which is a platform on which the observers are seated. Small holes pierced in the metal at the proper

points show up as stars when the interior is darkened, the light coming in from the outside giving the effect of star light. The sphere rotates so that the stars for all seasons of the year may be seen in their proper positions relative to an observer located in Chicago.

In order that the principles of navigation can readily be explained, several additions to the sphere have been made. A new lighting system has been installed; a meridian, and a movable arc, which measures the zenith distance of any particular star, have been constructed. These changes will make it possible to demonstrate graphically the principles on which the science of navigation is based.

Commander Williams plans to bring his classes to the sphere for practical lectures and, since over 900 men enter the training school every three months, it will mean that a great number of potential admirals will receive some of their fundamental training in navigation by means of the Atwood Sphere. The Academy welcomes this opportunity to share in the program of national defense.

New Members

The following have recently become associate members of the Academy: Kristian Baun, Miss Veronica Camutz, Tom Daggy, Mrs. Alice K. Gonnerman, Allan W. Gonnerman, Allan R. Humason, Miss Helen LaBuy, Charles H. Seevers, Miss Vera Wood, Miss Ann Moore, all of Chicago; Mrs. H. H. Belding, Jr., of Glencoe, and Paul Springer of LaGrange.

New Laboratory Space

The portion of the fourth floor which has housed the Academy's research collection of mammals for several years has been walled off to provide a laboratory for Dr. D. M. Hatfield who recently joined the staff of the Academy as Curator of Mammals. Without heating and ventilating facilities it has been hitherto impractical to use the fourth floor other than for storage of research materials.

Scientific Meetings

Dr. Eliot C. Williams, Assistant to the Director, and Donald C. Lowrie, Assistant Curator, attended the meetings of the American Association for the Advancement of Science in Philadelphia, December 26 to January 2. Mr. Lowrie presented a paper entitled, "A Comparative Study of the Spiders of the Dunes Areas of Chicago," before a joint session of the Ecological Society of America and the Entomological Society of America.

Lecture by Dr. Pettingill

Under the auspices of the Illinois Audubon Society, Dr. Olin S. Pettingill, Jr., of Carleton College, Northfield, Minnesota, will give a lecture entitled, *Birds that Haunt the Waterways,* in the auditorium of the Academy at 8:00 P.M., Monday, February 3. This lecture, illustrated by motion pictures in color, is free to the public.

Dr. Gloyd gave an illustrated lecture on the origin of birds at the Illinois State Museum, Springfield, December 17.

The daily weather map, issued by the U. S. Weather Bureau, is now being received by the Academy. The maps are posted each day on the bulletin board in the lobby. If you find that we are having too much weather of one sort or another, stop in and see how much worse it is in some other section of the country.

Test Your Nature Lore

Answers to questions on page 124:

1—False; 2—False; 3—False; 4—True; 5—True; 6—False; 7—True; 8—True; 9—False; 10—False.

Unresting Cells

By R. W. Gerard

Harper and Brothers, New York. 1940. $3.00.

This is a synthesis and interpretation of the latest developments in biological science. It deals with such pertinent questions as the origin of life; crystal and molecular structure; chemistry of protoplasm; metabolism of glucose, fats and proteins; nerve and muscle physiology; hormones, vitamins, enzymes, auxins and immune bodies; the mosaic virus; structure and mutation of genes; development of the embryo; cancer; old age.

It gives briefly the newer methods of examination of the contents of the living cell, growth of cells and tissues in media, and the use of such apparatus as the spectroscope, centrifuge, ultramicroscope, thermopile and the roentgen and radio-active rays in recent research.

Despite the use of such terms as syncytium, entelechies, milieu and dismutation, and the development of such formulas as cholesterol, tryptophane, adrenalin and thyroxine, the text brings together in an authoritative way the up-to-the-minute advances in biological research. Since much of this material is not available elsewhere it should be accessible for topical assignment to advanced biology students. Any difficulties that the student might have would be largely those inherent in the topics treated, for the exposition is clear cut and a wealth of verbal and graphic illustration is presented.

—J. E. Coe

The Wilderness Lives Again

By Mary L. Jobe Akeley

Dodd, Mead & Company. 1940. xv. 411 pages, 31 plates. $3.50.

A travel book, an animal book, a biography—all in one. The African expeditions of Carl Akeley are recounted with vivid descriptions (the only popular account I know of) of the big game museum technique developed and so successfully executed by Akeley. The natural history and habits of elephants and gorillas, and the subsequent mounting of groups of these animals for the American Museum, take the major portion of the book.

Although apparently intended primarily as a eulogy of Carl Akeley, whose name unquestionably leads the roster of those who have contributed to modern museum exhibition methods, the average reader will no doubt feel that the constant repetition of "Carl did this" and "Carl did that" is somewhat overdone.

The need for conservation, especially of the larger African mammals, in addition to the history of the man and his ideals, is the constant thread running through the entire book. It is not a sloppily sentimental view of dying fauna that Mrs. Akeley presents, but rather a realistic view based on the experiences of Akeley and herself on many expeditions. Several years ago a revered "conservationist" died, mourned by all conservation agencies. In his later years he had been adamant against

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THE NATURALISTS CALENDAR OF EVENTS

Amateur Herpetologists' Group, W. L. Necker, Chicago Academy of Sciences, Diversey 5871. Meetings at Academy second Tuesday of each month, 8:00 P.M.

Chicago Academy of Sciences, Lincoln Park at Clark and Ogden Ave., Diversey 5871.

Chicago Aquarium Society, Mr. Harmon K. Greene, Secretary, Plaza 2088. Meetings third Wednesday of each month. 8:00 P.M.

Chicago Cactus Society, Mr. Frank K. Balthis, President, Garfield Park Conservatory, Kedzie 1281. Meetings last Sunday each month, Garfield Park Conservatory, 3:00 P.M.

Chicago Entomological Society, Mr. Alex K. Wyatt, 5909 N. Virginia Ave., Ravenswood 3115.

Chicago Ornithological Society, Mr. Rudyerd Boulton, President, Field Museum, Wabash 9410. Meetings third Tuesday each month. Eleanor Club, Stevens Bldg. 8:00 P.M.

Friends of Our Native Landscape, Miss R. B. Eskil, 6016 Ingleside Ave., Hyde Park 8313.

Geographic Society of Chicago, 7 S. Dearborn St., Randolph 5293.

Illinois Audubon Society, Chicago Academy of Sciences. Diversey 5871.

Marquette Geologists Association, Mr. George J. Huss, Secretary, Canal 1828. Meetings at Academy first Saturday of each month, 8:00 P.M.

Mid-West Horticultural Society, Administration Building, Garfield Park, Van Buren 8100. Meetings last Friday each month.

Prairie Club, 38 S. Dearborn St., Dearborn 3737.

State Microscopical Society of Illinois, W. L. Necker, Chicago Academy of Sciences, Diversey 5871. Meetings at Academy third Friday of each month, 8:00 P.M.

Wild Flower Preservation Society, Mrs. R. M. Strong, 5840 Stony Island Ave.

Jan. 9 Prairie Club. Summer Excursions Meeting (Movies—Club Office).

Jan. 9 Chicago Entomological Society, Chicago Academy of Sciences. 7:30 P.M.

Jan. 9 Men's Garden Club of Chicago Region, Brevoort Hotel. 12:00 Noon.

Jan. 10 Prairie Club. Movie Meeting (Club Office).

Jan. 11 Prairie Club. Lincolnwood to Edgebrook (Sat. walk).

Jan. 12 Prairie Club. Salt Creek Hike (Sun. walk).

Jan. 12 Chicago Academy of Sciences, public lecture, *Mysterious Jungle*. Harold D. Fish. 3:00 P.M.

Jan. 15 Chicago Aquarium Society. Central Y. M. C. A., 19 S. LaSalle St., Dr. Julian Steyermark, *Exploration in Guatemala*. Dinner 6:30. Lecture 7:30.

Jan. 17 State Microscopical Society of Illinois, Chicago Academy of Sciences. 8:00 P.M.

Jan. 18 Wild Flower Preservation Society. Luncheon at Cordon Club, 410 S. Michigan Ave., Mrs. A. S. Park, *Springtime in Natchez and the Evangeline Country; Jungle Gardens of Louisiana*. 12:30 P.M.

Jan. 18 Prairie Club. The Sag-Lamont (Sat. walk).

Jan. 19 Prairie Club. Brookfield Circle (Short Sun. walk).

Jan. 19 Chicago Academy of Sciences, public lecture, *Old Ghost Falls*. Harold D. Fish. 3:00 P.M.

Jan. 19 Chicago Entomological Society. Academy Library. 2:00 P.M.

Jan. 21 Prairie Club. Annual Meeting (Fullerton Hall). 8:00 P.M.

Jan. 21 Prairie Club. Open Meeting (Fullerton Hall). 8:00 P.M.

Jan. 21 Friends of our Native Landscape. Annual Meeting. T. H. Frison, *Features of our Conservation Work Involving Land Utilization, Wild Life, and Forestry.* Chicago Engineers Club. 8:00 P.M.

Jan. 21 Chicago Ornithological Society. *Behavior of Young Passerines.* Margaret M. Nice. Eleanor Club, Stevens Bldg. 8:00 P.M.

Jan. 21 Chicago Chapter of Biological Photographic Assoc. Discussion by Dr. Tibor Benedek of a special book-copying device with a demonstration of the equipment. Room 634. 310 S. Michigan Ave.

Jan. 25 Prairie Club. Morton Arboretum (Sat. walk).

Jan. 26 Prairie Club. Harms Woods-Edgebrook (Sun. walk).

Jan. 26 Chicago Academy of Sciences, public lecture. *Local and Southern Gardens,* Dr. C. O. Schneider. 3:00 P.M.

Jan. 26 Chicago Cactus Society, Garfield Park Conservatory. 3:00 P.M.

Jan. 31 Midwest Horticultural Society. Administration Bldg., Garfield Park. 8:00 P.M.

Feb. 1 Prairie Club. Brookfield to Westchester (Sat. walk).

Feb. 1 Marquette Geologists Association. Dr. J. D. Willems, colored movies of the West. Chicago Academy of Sciences. 8:00 P.M.

Feb. 1-2 Prairie Club. Winter Week-End (Pokagon State Park).

Feb. 2 Prairie Club. Winter Picnic (Short Sun. walk).

Feb. 2 Chicago Academy of Sciences, public lecture. *Ceramics, Illinois' Most Ancient and Indispensable Industry.* Professor C. W. Parmelee, 3:00 P.M.

Feb. 3 Illinois Audubon Society, Dr. O. S. Pettingill, *Birds that Haunt the Waterways.* 8:00 P.M. Academy Auditorium.

Feb. 3 Geographic Society of Chicago. *Negro Cultures of South and Central Africa,* Wilfrid D. Hambly, D. Sc. Goodman Theatre. 8:15 P.M.

Feb. 9 Chicago Academy of Sciences, public lecture. *Recent Advances in Our Knowledge of Sleep.* Dr. Nathaniel Kleitman. 3:00 P.M.

Feb. 11 Amateur Herpetological Group. Chicago Academy of Sciences. 8:00 P.M.

Feb. 12 Field Museum, Children's movies at 10:00 and 11:00 A.M.

Feb. 13 Men's Garden Club of Chicago Region, Brevoort Hotel, 12:00 Noon.

Feb. 13 Chicago Entomological Society, Chicago Academy of Sciences. 7:30 P.M.

Feb. 16 Chicago Academy of Sciences, public lecture. *Silurian Studies in Southern States.* Dr. John R. Ball. 3.00 P.M.

Feb. 16 Chicago Entomological Society, Academy library. 2:00 P.M.

Feb. 18 Chicago Ornithological Society. *Social Nesting Habits of Crotophaginae.* David E. Davis. Eleanor Club. Stevens Bldg. 8:00 P.M.

Feb. 19 Chicago Aquarium Society. Central Y. M. C. A., 19 S. LaSalle St. Dinner at 6:30; lecture at 7:30 P.M.

Feb. 20 Wild Flower Preservation Society. Mrs. Charles R. Walgreen. *Kodachromes of Wild Flowers and Garden Flowers.* Cordon Club, 410 S. Michigan Ave., Webster 0312. 2:00 P.M.

Feb. 21 State Microscopical Society of Illinois, Chicago Academy of Sciences. 8:00 P.M.

Feb. 22 Field Museum, Children's movies at 10:00 A.M. and 11:00 A.M.

Feb. 23 Prairie Club. Annual Mountain Climb (Dunes—Sunday Walk).

Feb. 23 Chicago Academy of Sciences. Public Lecture. *Patterns of Negro Music.* Dr. Melville J. Herskovits. 3:00 P.M.

Feb. 23 Chicago Cactus Society. Garfield Park Conservatory. 3:00 P.M.

Feb. 28 Midwest Horticultural Society. Administration Bldg. Garfield Park. 8:00 P.M.

March 2 Chicago Academy of Sciences. Public Lecture. *New England Mountains in Autumn.* Dr. Louis J. Tint. 3:00 P.M.

March 3 Geographic Society of Chicago. *Peoples of West and North Africa.* Melville J. Herskovits, Ph.D. Goodman Theatre. 8:15 P.M.

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shooting of game for any reason; forgotten was the fact that in his younger days he had spread a path of gore across Africa and Asia for "museum" purposes. Neither of these extremes of one individual are commendable conservation! Mrs. Akeley brings out exceptionally well the care in choosing an animal to be shot for exhibition—a care not now limited to a few museum collectors but practiced universally. May her plea for conservation be heeded.

—Walter L. Necker

Flora of Indiana

By Charles C. Deam

Indianapolis: Department of Conservation, 1940. 1236 pages, 2243 maps. $3.50.

Dr. Deam is the acknowledged authority on the botany of Indiana; his previous books, *Trees of Indiana, Shrubs of Indiana,* and *Weeds of Indiana,* would have assured him this title. The present book leaves no words sufficiently complimentary. The book describes and keys down 1,838 species of native plants and 302 introduced species, as well as 390 additional varieties and forms and 38 hybrids. For each plant, a limited synonymy and references, ecology, general distribution, and a map of distribution in Indiana, is included.

An excellent glossary of botanical terms, as well as habitat and distributional terms which is a commendable innovation, serves to make the book especially useful to the layman.

For the more serious student, a list of 707 deletions from the flora of the state and a list of herbaria and collectors are included. There is a comprehensive index.

—Walter L. Necker

Natural History of Birds of Eastern and Central North America

By John Bichard May

Houghton Mifflin Comnany, Boston, 1940. 579 pages, 97 colored plates. $4.95.

This book will be welcomed by bird lovers who have found *Birds of Massachusetts and Other New England States* beyond their means. The author, John Bichard May, has abridged this fine three-volume work into one, and reduced the number of pages from 1,545 to 579.

Mr. May worked with the late Edward Howe Forbush, author of *Birds of Massachusetts,* and finished the third volume after the author's death. Therefore, he is well qualified to condense this work. Although the text has been greatly abridged, over one hundred species not found in *Birds of Massachusetts* have been added.

For sheer readability *Natural History of Birds* has no equal. It contains life histories as well as complete and accurate description of all of the birds found east of the Dakotas, Nebraska, and Kansas, with Florida on the south and eastern Canada on the north.

Four new color plates by Roger Tory Peterson have been added to the ninety-four executed by Major Allen Brooks and the late Louis Agassiz Fuertes for the unabridged edition.

—Earl G. Wright

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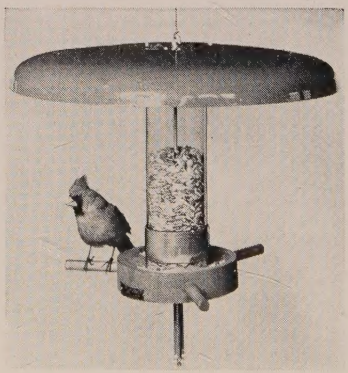

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